STM JOURNALS

Journal of Water Resource Engineering and Management
ISSN: 2349-4336 (online)
Volume 1, Issue 2
www.stmjournals.com

Water Harvesting Through Application of Social Marketing Strategy - A Case Study in Banwar Village, Madhya Pradesh, India

Mahesh Rao[1]*, Sendhil R.[2], Narendra Singh Chandel[3], V. Rajagopal[4], Sangeeta Mandal[5], Monika Shukla[6], Pradip Karmakar[7], Atmanand Tripathi[8]

[1]National Research Centre on Plant Biotechnology, New Delhi, India
[2]Directorate of Wheat Research, Karnal, India
[3]Central Institute of Agricultural Engineering, Bhopal, India
[4]National Institute of Abiotic Stress Management, Baramati, India
[5]National Bureau of Fish Genetic Resources, Lucknow, India
[6] Central Arid Zone Research Institute, Jodhpur, India
[7]Indian Institute of Vegetable Research, Varanasi, India
[8]Central Research Institute for Jute & Allied Fibres, Barrackpore, India

Abstract

The present study was carried out in a dry tract of central plateau region (Banwar village, Madhya Pradesh, India) by a team of trainee scientists inducted for the National Agricultural Research System (NARS), India. Observations recorded in the village indicated the harsh effects of declining water table owing to poor precipitation and the need for water harvesting to sustain people's livelihood since agriculture being their primary profession. Considering social marketing strategy, the goal was set to recharge groundwater and increase the water availability for irrigation purpose. Visualising groundwater recharge through water harvesting as the end product; organising training programmes, method demonstrations, village level exhibitions and visit to other successful water harvesting regions were set as the promotion strategies to achieve the set goal. Work plan was devised by the trainee scientists and set to act further. Nevertheless, successful social marketing needs the partnership of local government bodies and nongovernmental organizations (NGOs) that play a significant role in changing the complex social structure of the people—the ultimate beneficiaries of end product.

***Keywords**: social marketing, Banwar village, water harvesting, groundwater recharge*

****Author for Correspondence*** E-mail: mraoiari@gmail.com

INTRODUCTION

India has more than half of its population engaged in agriculture today with 13.9 % share in the nation's GDP (Economic Survey, 2011–2012) [1]. The country undergone rapid strides in food production during the past four decades through intensive agriculture, attained the status of self-sufficiency in food production and also enhanced its capacity to cope with inter-year fluctuations in production [2]. Despite this accomplishment, intensification of agriculture and increasing area under irrigation post-green revolution resulted in heavy exploitation of groundwater resources in the country.

Groundwater depletion has become an increasingly important policy concern across the countries especially in India— the largest user of groundwater for irrigation in the world [3]. Shankar *et al*. reported that the amount of groundwater drawn in India was estimated to be 210 billion cubic meters per annum against 105 billion cubic meters in China and 100 billion cubic meters in United States [4]. Among countries, India's water stress indicator [5] showed that a majority of the

region is either heavily exploited or over exploited. Owing to this, most of the agricultural researches in the recent past focus mainly on conserving water resources and strategies to increase the agriculture productivity and profitability, maintaining ecological balance and adapting the impact of climate change.

Burgeoning population has a substantial impact on future food and water demands. The most critical issue is that there exist a significant spatial mismatch between the Indian population and its water resources; less water is available in places where more people live and much of the food is grown [6]. Thus, the strategy under which India plans to meet its increasing food and water demands have been the prime focus of many research studies both at global [6–10] and national level [11–13].

Madhya Pradesh with an area of 308252 Km^2 often called the Central or Heart of India is one of the states which consume more groundwater for irrigation. The economy is largely dependent on agriculture next to services sector. It contributes 26.5 % to the country's agriculture GDP (2009–2010). The major concern is agriculture is not as lucrative as earlier because of depleting water resources. The region is projected to experience physical water scarcity by the year 2025 (Figure 1) as estimated by the International Water Management Institute (IWMI). Most of the research reports including IWMI warn that a number of existing tube wells in the State have gone dry already and efforts to set new ones or deepening the existing wells have either yielded no water or a limited supply of poor quality water unfit for irrigation. The water tables in some parts of the region have declined over the years to almost 200–300 feet below the ground level [14].

Declining water table can be contained by adopting rain water harvesting [15]. It is the practice of rain water accumulation and storage for irrigation before it reaches the aquifer. Encouraging farmers to build their own harvesting structures helps to conserve monsoon rain water for irrigation has reaped widespread benefits in Madhya Pradesh, India [14]. The activity of artificial recharge to groundwater is an indispensable measure which is substantially beneficial, as this will help store the surplus rain water in the form of groundwater and in turn arrest the decline of water level and degradation of the quality [16]. In the milieu, the present participatory study was carried out with the aim of suggesting water harvesting technique to the specific goal of recharging groundwater and increasing the water availability for irrigating crops.

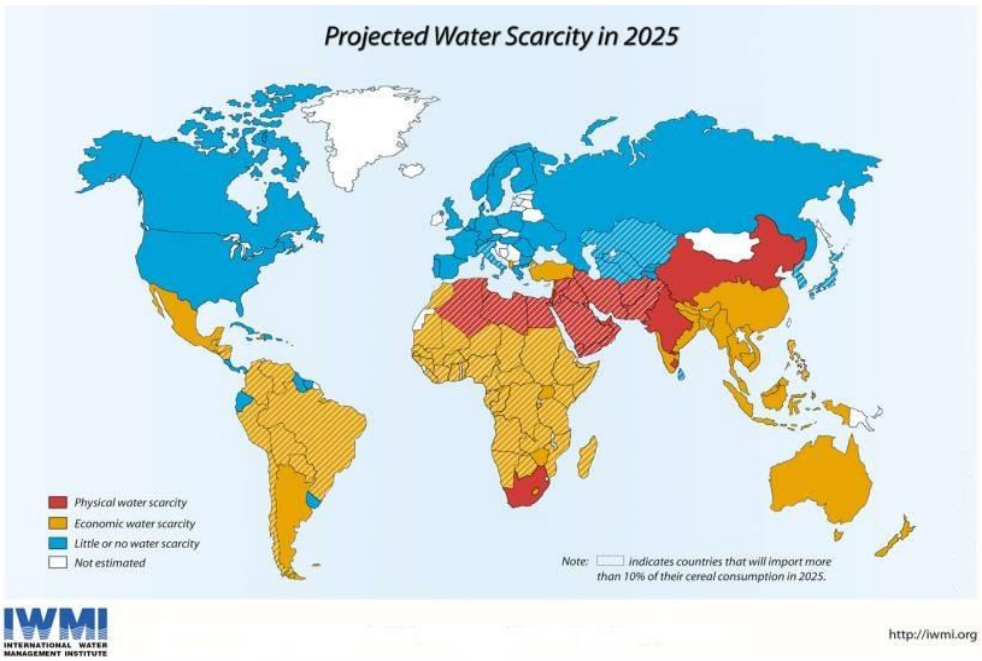

Fig. 1: *Projected Water scarcity for Different Countries by 2025.*

METHODS

The present study was carried out as a part of induction training by a team of trainee scientists inducted for the National Agricultural Research System (NARS), India. The training firmly anchored on the principle of 'seeing is believing' and 'learning by doing'. The team was a multidisciplinary comprising of Plant Pathology, Horticulture, Agricultural Engineering, Agricultural Economics, Soil Science and Agricultural Chemistry, Fisheries Resource Management, Plant Genetics and Agronomy. The study was conducted in Banwar village (Gwalior district), Madhya Pradesh located in the dry tract of central plateau region of India. The village is well known for the water scarcity problem due to the declining water table. Data were collected during 2011 from the respondents of the village through Participatory Rural Appraisal (PRA) techniques like transect walk, livelihood analysis, and problem identification and ranking. The complexities of problem involved in agriculture can be well understood through PRA and hence, it is a well-established approach for systematic and rapid collection of information.

RESULTS AND DISCUSSION

The information collected with the help of various PRA techniques applied in Banwar village are furnished and discussed in this section. The village is located at 26^0 01.69' latitude and 78^0 04.464' longitude (Figure 2) with an altitude of 850 ft above the mean sea level (MSL). It received 425 mm of rainfall during 2011 with temperature ranging from 6–47 ^{0}C and relative humidity ranging from 30–40%.

Basic Information of the Village

Geographical Co-ordinates

- Latitude : 26^0 01.69'E
- Longitude : 78^0 04.464'N
- Altitude : 850 ft MSL

Weather Parameters

- Mean Annual Rainfall : 425 mm
- Max. Annual Temperature : 47 ^{0}C
- Min. Annual Temperature : 6 ^{0}C
- Relative Humidity : 30–40 %

Demographic Patterns (2001 Census)

- Number of households : 1246
- Total population : 5000
- Number of males : 2462
- Number of females : 2538
- Literacy : 60 %

Fig. 2: *Satellite Picture of Banwar Village.*

Agricultural Scenario

Land Use Pattern (In Hectares)

- Total area : 1766
- Gross cropped area : 2056
- Net cultivated area : 1483
- Cropping intensity : 138.63 %
- Total cropped area (*Kharif*) : 831
- Total cropped area (*Rabi*) : 1225
- Irrigated area : 231
- Rainfed area : 1252
- Residential area : 520
- Total area under fallow/ barren land : 94
- Total area under rivers and ponds : 35
- Total area under grazing land : 40

The cropping intensity was estimated at 139 per cent with 1483 ha and 2056 ha, respectively under net cropped and gross cropped area. The main occupation of the village is agriculture. Secondary source of income is obtained from dairy enterprises. Further some families derive their income from government and private job. From the PRA technique it was found that 1162 families are involved in agriculture comprising of 3550 people. About 93 % of the households in Banwar village practiced agriculture. The distribution of land holdings is furnished in Table 1. It is evident from the table that majority are small farmers (42.86 %) followed by medium (28.49 %) and semi-medium (17.99 %) farmers.

Table 1: *Distribution of Land Holdings in Banwar.*

Land Holding	Number of Households	Share (%)
Large (> 10 ha)	62	5.34
Medium (4-10 ha)	331	28.49
Semi-medium (2-4)	209	17.99
Small (1-2 ha)	498	42.86
Marginal (<1 ha)	62	5.34
Total	**1162**	**100.00**

Pearl millet, black gram, red gram, soybean, sweet potato and sesame were the major crops grown in *Kharif* season (Table 2). Mustard, wheat, pea, potato, coriander, onion and chickpea were grown in *Rabi* season. Groundwater is the major source of irrigation which is evident from the number of irrigation sources *viz.*, open well, bore well, pond and river (Table 3).

Table 2: *Share of Different Crops in Banwar Village (2011).*

Crop	Area share (%)
Mustard	28.98
Wheat	20.60
Pearl millet	18.84
Chickpea	9.81
Sweet potato	8.12
Soybean	7.34
Pea	2.92
Potato	1.69
Jowar	0.52
Black gram	0.39
Brinjal	0.32
Tomato	0.19
Rice	0.19
Water chestnut	0.06

Livelihood Analysis

The entire village households were divided into four categories, *viz.*, rich, medium, poor and landless laborers. The livelihood status of these categories in terms of both income and expenditure was assessed by selecting representative households from each group with the help of key informants of the village. The analysis indicated that the rich and medium farmers received their income principally from agriculture and/or business and service (government/private). Poor families earn their income solely from agriculture and the landless labourers completely depend on agricultural jobs for their livelihood.

Problem Identification

After understanding and analysing the basic information of the village, constraints faced by the farmers were identified with the help of key informants. Twenty four farmers were identified using snowball sampling technique (a nonprobability sampling where existing farmers include new farmers among their acquaintances) to discuss the problems in the village. From this PRA technique, twelve problems were identified from their perception and presented in Table 4. After identification, farmers were asked to rank them according to their perception about severity of the problem. Maximum of eight ranks were given to the farmers. Based on ranking, scarcity of groundwater topped the list followed by grazing by wild cows (Table 4).

Problem and Solution Tree

It is a short dendrogram analysis wherein, all the possible reasons for the identified problem were analysed using top–down approach. The possible solution for each cause was also discussed with the farmers. Accordingly, the problem (indicated by small letter) and solution (indicated by caps letter) tree was prepared for the problem of water scarcity in Banwar village (Figure 3).

These were deliberately discussed with the subject matter specialists before finalising the solution under this PRA tool. The problem and solution tree indicates that water scarcity is caused by low groundwater table as a result of excess use of irrigation water, uncertain rainfall and lack of adoption of *in situ* water conservation technologies.

Among them, rainfall is not under the control of farmers. The rest causal factors can be solved by creating awareness on the benefits of water harvesting and adopting the technology to reap the desired benefit.

Table 3: *Water Bodies Available for Irrigation.*

Water Bodies	Number	Remarks
Open well	100	Most of them dried during summer
Bore well	50	Groundwater available at lower depth
Pond	1	Seasonal pond based on rainfall
River	1	Nun river which is also seasonal based on rainfall

Table 4: *Problems Identified by the Farmers in Banwar.*

S.No.	Problems Identified	Rank (n =24)							
		1	2	3	4	5	6	7	8
1	Scarcity of groundwater	20	2	2	-	-	-	-	-
2	Bajra smut	-	2	7	5	3	4	2	1
3	Mustard aphid	1	2	10	5	4	2	-	-
4	Pod borer of chickpea	5	6	9	5	-	-	-	-
5	Chickpea wilt	5	9	4	3	2	2	-	-
6	Diamond back moth in cauliflower	4	5	9	3	1	2	-	-
7	Potato stem necrosis	6	4	3	8	3	2	-	-
8	Sweet potato weevil	10	7	5	2	-	-	-	-
9	Shoot & fruit borer of brinjal	3	8	5	4	4	-	-	-
10	Powdery mildew in pea	2	3	6	7	4	2	-	-
11	Health problems of animals	5	15	3	1	-	-	-	-
12	Grazing by wild cows	17	5	2	-	-	-	-	-

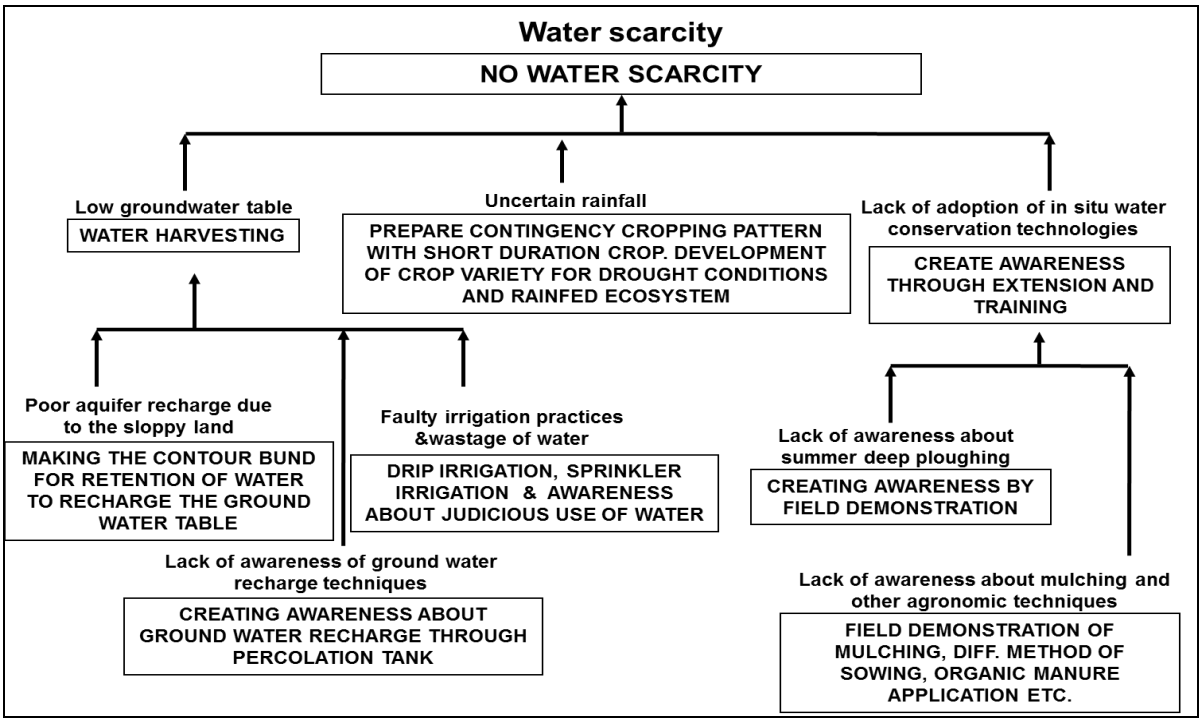

Fig. 3: *Problem and Solution Tree.*

Social Marketing

Considering the issue of low rainfall and depleting groundwater table (price), social marketing strategy was thought to be applied to increase the groundwater table by promoting water harvesting technique in the village. The characteristic features of social marketing are furnished in Table 5.

Social marketing aims to change people's behaviour to become healthier or to improve the society or the world. Behavioural change is achieved by two phenomena—education, which uses rational facts to persuade people to change their behaviours; and coercion, which forces people to adopt certain behaviour. Somewhere in between education and coercion lies the social marketing— use of commercial marketing principles to persuade people to change their behaviours. The objective of social marketing in our case is to promote water harvesting which should recharge groundwater and increase the water availability for irrigation in long term. This can be achieved or promoted through training programmes, method demonstrations, village level exhibitions and visit to successful sites and should be done by the Krishi Vigyan Kendra (KVK), Department of Farmer Welfare and Agriculture Development (FWAD), Gwalior and local NGOs.

The intended beneficiaries (public) should be the farmers and villagers of Banwar village. The beneficiaries should utilise the subsidies (policy) offered by the state government for constructing water harvesting structures. However, they should work out the benefit–cost analysis and take care of their budgetary constraints too. Anonymous (2011) reported that benefit–cost ratio (BCR) varies between 1.48 and 1.92 with no government subsidy and the payback period was 2.5–3.1 years [14]. With the subsidy of INR 80000, the BCR varies from 1.72 to 2.39 with payback of 1.9–2.6 years.

By increasing the availability of irrigation water and improving farming practices, farmers who have invested in water harvesting structures, have seen real increases in both crop yields and their incomes [14]. This kind of positive impacts should be communicated to the farmers through appropriate communication channel. Interpersonal channels like progressive farmers, Agriculture Department officer, subject matter specialist from KVK, method demonstration and training programmes should be utilised. Further, depending upon the intensity of the problem, mass media channels like local television channel, radio and newspapers should be used.

Table 5: *Social Marketing Features Applicable to Banwar Village for Water Harvesting.*

Particulars	Target
Goal	To recharge groundwater and to increase the water availability for irrigation purpose
Objective	To promote water harvesting for irrigation purpose
Product	Water harvesting
Price	Continuous low rainfall (below 500 mm) and ground water depletion
Place	Banwar, KVK and Department of Farmer Welfare and Agriculture Development (FWAD)
Promotion	Training programmes Method demonstration Village level exhibition Visit to water harvesting structures in successful areas
Public	Primary audience: Farmers and villagers Secondary audience: Professionals from KVK and FWAD
Partnership	KVK + District Agriculture Department + NGO
Policy	Balram Talab Yojna by dept. of soil conservation of M.P Govt. give up to 70% subsidy to construct water harvesting structure
Purse String	Provision for budget

Table 6: *Work Plan for Water Harvesting.*

Phase	Task	Promotion	Staff	Place
Before monsoon	To create awareness about water harvesting	Visit to water harvesting sites, exhibitions	KVK (SMS), ADO	KVK, District Agriculture Department, NGO
Before crop season	Training on construction of water harvesting structure	Training for progressive farmers	Researcher, KVK (SMS), ADO	SAU, KVK, District Agriculture Department, NGO
During crop season	Construction of water harvesting structure and training on effective & judicious use of rain water	Method demonstration	KVK (SMS), ADO	KVK, District Agriculture Department
During monsoon		Training for progressive farmers	District Agriculture Department	District Agriculture Department/ SAU/ KVK

To achieve the set target, a work plan (Table 6) was devised and submitted to the concerned personnel and officials for their kind perusal and necessary action. The plan was set for four phase's *viz.*, before monsoon, before crop season, during crop season and during monsoon. The task which has to be performed at each phase and the promotion strategy has been furnished along with the place of social marketing.

CONCLUSIONS

PRA techniques indicated that agriculture is the basic livelihood of Banwar village and due to intensive farming and over use of irrigation water, groundwater table declined drastically. Water harvesting was suggested as a solution to this crucial environmental and social issue. Social marketing principles were considered to harvest rain water with the objective of increasing the groundwater table. Skill training, method demonstrations, exhibitions and visit to neighbouring water harvesting sites were set as the promotion tools to get the desired outcome. Accordingly, work plan was devised with the consultation of the experts and set to act further. However, the success depends on the linkage between organisations which play crucial role in changing the social behaviour. Further, access to loans, subsidies and technical support will speed up the process to reap the set goal.

ACKNOWLEDGEMENTS

The authors wish to thank the inhabitants of Banwar village and National Academy for Agricultural Research Management (NAARM), Hyderabad, India for facilitating the study.

REFERENCES

1. Amarasinghe UA, Shah T, Anand BK. India's water supply and demand from 2025–2050: Business-as-usual scenario and issues. *Conference Papers from International Water Management Institute*; 2008; Colombo, Sri Lanka. Sri Lanka: International Water Management Institute; 2008. Available from: http://www.iwmi.cgiar.org/publications/Other/PDF/NRLP%20Proceeding-2%20Paper%202.pdf
2. Anonymous. Rain water harvesting in Madhya Pradesh. *Agricultural Water \Management Learning and Discussion Brief*; 2011 May; Madhya Pradesh, India. India: AGWater Solutions; 2011. Available from: http://awm-solutions.iwmi.org.
3. Bhalla GS, Hazell P, Kerr J. Prospects of India's cereal supply and demand to 2020. *Food, Agriculture and the Environment Discussion Paper 29*; 1999 Nov; Washington DC, USA. USA: International Food Policy Research Institute (IFPRI); 1999.
4. Central Ground Water Board. *Rain water harvesting techniques to augment ground water*. Faridabad, India: Ministry of Water Resources; 2003.
5. Dyson T, Hanchate A. India's demographic and food prospects: State level analysis. *Economic and Political Weekly*. 2000 Nov; 11: 4021–36p.
6. Ministry of Finance. *Economic Survey 2011–12*. New Delhi: Ministry of Finance, Government of India; 2012. Available from: http://indiabudget.nic.in
7. Government of India (GOI). *Integrated water resources development. A plan for action*. *Report of the Commission for Integrated Water Resource Development Volume I*. New Delhi, India: Ministry of Water Resources; 1999.
8. International Water Management Institute (IWMI). *World water supply and demand 1995 to 2025 (draft)*. Colombo, Sri Lanka: IWMI; 2000. Available at www.cgiar.org/iwmi/pubs/WWVison/WWSDOpen.htm
9. Narain P, Khan MA, Singh G. *Potential for water conservation and harvesting against drought in Rajasthan, India. Working Paper 104 (Drought Series: Paper 7)*. Colombo, Sri Lanka: International Water Management Institute (IWMI); 2005.
10. Nasurudeen P, Kuruvila A, Sendhil R, *et al.* The dynamics and inequality of nutrient consumption in India. *IJAE.* 2006; 61 (3): 362–70p.
11. Rijsberman FR. *World water scenarios: Analysis*. London, UK: Earthscan Publications; 2000.
12. Rosegrant MW, Cai X, Cline SA. *World water and food 2025: Dealing with scarcity.* Washington DC, USA: International Food Policy Research Institute; 2002.
13. Seckler D, Amarasinghe UA, Molden D, *et al*. *World water demand and supply 1995 to 2025: Scenarios and issues. Research Report No. 19*. Colombo, Sri Lanka: International Water Management Institute; 1998.
14. Sekri S. *Sustaining groundwater: Role of policy reforms in promoting conservation in India.* New Delhi: India International Centre, India Policy Forum; 2012.
15. Shankar PV, Kulkarni H, Krishnan S. India's groundwater challenge and the way forward. *Economic and Political Weekly*. 2011; 46: 2p.
16. Smakhtin V, Revenga C, Doll P. *Taking into Account Environmental Water Requirements in Global-scale Water Resources Assessments. Comprehensive Assessment Research Report 2*. Colombo, Sri Lanka: Comprehensive Assessment Secretariat; 2004. Available from: http://www.iwmi.cgiar.org/assessment/files/pdf/publications/ResearchReports/CARR2.pdf.